Original Article

Code Blue evaluation in children's hospital

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BACKGROUND: True alarm rate of the Code Blue cases is at a low level in the Dr. Behçet Uz Children's Hospital in İzmir. This study aims to analyse the use of the Code Blue alarm cases in the children's hospital.

METHODS: This retrospective clinical study evaluated the age and the gender of the cases, the arriving time of the Code Blue team, the date and time of the Code Blue Call, the reasons of the Code Blue Call, and the verification which were all obtained from the Code Blue forms of the hospital dated between January 2014 and January 2015. The data of 139 Code Blue cases' forms were investigated and was divided into two groups: before and after the education containing 88 and 51 cases, respectively.

RESULTS: Conversive disorder (26% to 13%, $P<0.01$), syncope (21.5% to 19.6%, $P<0.01$), convulsion (17% to 13.7%, $P<0.01$), hypoglycemia (4.5% to 3.9%, $P<0.01$), anxiety (4.5% to 1.9%, $P<0.01$), head trauma due to syncope (4.5% to 0%), cardiac arrest (1.1% to 0%), respiratory difficulties (2.2% to 1.9%, $P<0.01$), suspicion of myocardial infarction (2.2% to 1.9%, $P<0.01$), fall from stairs (2.2% to 0%) and agitation cases (1.1% to 0%) were reduced, however, the hypertension cases were dramatically increased (3.4% to 29.4%, $P<0.01$) owing to the hospital staff's education. The Pearson's correlation coefficient before and after education was 0.837. About 97.8% of the Code Blue cases were false calls with female greater than male ($P<0.01$).

CONCLUSION: The results of this study show that more education is required for the hospital's staff and a new color code that is to say pre-diagnosis team should be formed.

KEY WORDS: Code Blue; Cardiopulmonary resuscitation; Hospital arrest

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INTRODUCTION

Code Blue is the emergency management system that is formed by the cases in need of emergency medical intervention, case relatives or hospital staff. The process consists of a code that is announced by healthcare professionals and responded to by the designated personnel for intervention of cardiac arrest cases.[1–5] It is an emergency management tool that provides the quickest intervention. "Code Blue" is the only color code used for the same emergency case worldwide. Code Blue was used for the first time in Kansas Bethany Medical Center in the United States of America and common usage in our country was established in 2008 by implementation of service quality standards.[2] This system has become obligatory in 2009 with a formal notification by the Ministry of Health and Patient and Personnel Safety Regulations in 2011.[3] The successes of Code Blue was not compared with each other in previous studies in the related literature in terms of the effects of before-and-after education of the hospital staff.[6–12] This study presents the comparisons of the Code Blue cases where before-and-after education of the hospital staff is investigated in the Children Hospital. "Code Blue" responders and teams are determined in Dr. Behçet Uz Children's Hospital for quick intervention of cases in need of emergency medical intervention, case relatives or hospital staff. Three separate teams responsible for Code Blue are formed in our hospital for faster and more

efficient resuscitation. The Code Blue notification form is filled and sent to the Quality Management Department by the Code Blue responder after the intervention. These stages are similar to the other processes which are "run the code" and "blue code".[4,5] The inspected Code Blue forms are dated from January 2014 to January 2015 retrospectively as the Code Blue Responding Team and evaluated the application of Code Blue in the hospital.

METHODS

The retrospective clinical study evaluated the age and the gender of the cases, the arrival time of the Code Blue team, the date and time of the Code Blue Call, the reasons of the Code Blue Call, and the verification of the Code Blue codes which were obtained from the Code Blue forms of the Hospital dated from January 2014 to January 2015. There are approximately 100 000 emergency service admissions (including walk in clinics during night shifts) and 500 000 policlinics admissions annually. Three separate Code Blue teams were formed due to the physical characteristics of the Dr. Behçet Uz Children's Hospital (Policlinics, Surgery and Emergency service Code Blue Call teams). These teams are not composed of fixed staff, which include the doctors and the nurses. They work on a rotating shift schedule. All the teams used the same Code Blue notification forms controlled by the Hospital's Quality Management Department where all of the forms are combined and evaluated. Fourteen different reasons of Code Blue Call were detected during the evaluation of Code Blue Case Report Forms. Calls for "arrest" were grouped as true calls and "non-arrest" cases were grouped as false calls. Calls were grouped as calls during work hours (weekdays between 08:00–16:00) and calls during shifts (weekdays between 16:00–08:00 and weekend). Calls during official holidays were included in calls during shifts. Arrival time of the team to the place of the event was assumed as the time between Code Blue Call and the arrival of the team and recorded in minutes.

The process followed quality standards in accordance with AHA 2010 guidelines. The data from 139 Code Blue case forms were investigated and was approved by the hospital ethics committee. Cases developed in operation room and intensive care units were not considered. The overall code blue forms were divided into two groups. The first group had 88 cases during the first 9 months before the education of the hospital staff while the second group consisted of 51 after the education of the staff. The data was analyzed with SPSSv21 program in terms of cross-tabulation, frequency, mean, standard deviation and percentage.

RESULTS

Difference between diagnosis in the two groups (before and after education) were analyzed. Conversive disorder (from 26% to 13%, $P<0.01$), syncope (from 21.5% to 19.6%, $P<0.01$), convulsion (from 17% to 13.7%, $P<0.01$), hypoglycemia (from 4.5% to 3.9%, $P<0.01$), anxiety (from 4.5% to 1.9%, $P<0.01$), head trauma due to syncope (from 4.5% to 0%, $P<0.01$), cardiac arrest (1.1% to 0%), respiratory difficulties (from 2.2% to 1.9%, $P<0.01$), suspicion of myocardial infarction (from 2.2% to 1.9%, $P<0.01$), fall from stairs (from 2.2% to 0%) and agitation cases (from 1.1% to 0%) were reduced, however, the hypertension cases were dramatically increased (from 3.4% to 29.4%, $P<0.01$) owing to the hospital staff education. The Pearson's correlation coefficient between before-and-after education was 0.837. The mean time to arrival of the cases before education was 106.2 seconds while the mean time of arrival of the cases after education was 73.2 seconds.

There were 88 Code Blue Calls in the pre-education group between January-October 2014. Among them, 53 (60.2%) cases were females, while 35 (39.8%) were males. One hundred and thirty-six (97.8%) of the Code Blue cases were false calls where the number of false calls for female was dramatically greater than for males ($P<0.01$). The youngest of the cases was 2 years old and the oldest was 84 years old and the mean age was 27 years old. The age distribution of the cases was shown in Figure 1. Distribution of the personnel calling code blue was 13 (14.7%) doctors, 22 (25%) nurses, and 53 (60.2%) other hospital staff. Arrival time of the team to the Code Blue cases ranged from 1 to 5 minutes and

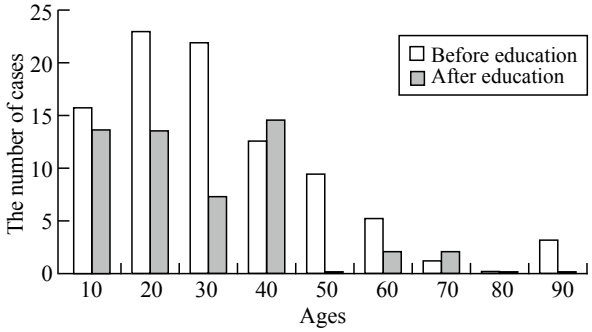

Figure 1. The age distribution of the cases.

the mean duration was 106.2 seconds. Arrival time was 1 minute in 42% of the cases, 2 minutes in 41% of the cases, 3 minutes in 16% of the cases and 5 minutes in 1% of the cases. Moreover, 68 (78%) of Code Blue Calls were performed during work hours and 20 (22%) were performed during shift hours. The most frequent Code Blue calls time interval was 09:00–12:00.

After education, 51 Code Blue Calls occurred between the dates of October 2014 to January 2015. Among them, 35 (68.6%) cases were females and 16 (31.4%) were males. The youngest of the cases was 3 months old and the oldest was 67 years old with a mean age of 22.61 years old. The age distribution of the cases was shown in Figure 1. Distribution of the personnel calling code blue was 6 (11.7%) doctors, 13 (25.4%) nurses, and 32 (62.7%) other hospital staff. Arrival time of the team to the Code Blue cases ranged from 1 to 5 minutes and the mean duration was 73.2 seconds. Arrival time was 1 minute in 82.4% of the cases, 2 minutes in 13.7% of the cases, and 3 minutes in 3.9% of the cases. Moreover, 44 (86.3%) of Code Blue Calls were performed during work hours and 7 (13.7%) were performed during shift hours. The most frequent Code Blue Calls time interval was 09:00–12:00.

In total evaluation of 139 Code Blue Calls, which occurred between the dates of January 2014 to January 2015, 88 (63.3%) of 139 cases were females, and 51 (36.7%) were male. The youngest patient was 3 months old and the oldest was 84 years old with a mean age of 26.01 years old. Distribution of the personnel calling code blue was 19 (14%) doctors, 35 (25%) nurses, 85 (61%) other hospital staff. One hundred and eleven (79.9%) of Code Blue Calls were performed during work hours and 28 (20.1%) were performed during shift hours. One (0.7%) of the code blue calls were for cardiac arrest, 2 (1.4%) of the code blue calls were for respiratory arrest, and 136 (97.8%) were for non-arrest cases. Respiratory and cardiac arrest cases responded to cardiopulmonary resuscitation in 1 minute. They were discharged after an interval of observation in the intensive care unit. Arrival time of the team to the Code Blue case ranged from 1 to 5 minutes and the mean duration was 94.2 seconds. Arrival time was 1 minute in 56.8% of the cases, 2 minutes in 30.9% of the cases, 3 minutes in 11.5%, and 5 minutes in 7% of the cases.

Education decreased arrival time of the Code Blue team dramatically in Figure 2 where the mean time of arrival of the cases before education was 106.2 seconds while the mean time of arrival after education was 73.2 seconds. Moreover, most diagnoses of the cases were affected positively which was given in Table 1 where conversive disorder (from 26% to 13%, $P<0.01$), syncope (from 21.5% to 19.6%, $P<0.01$), convulsion (from 17% to 13.7%, $P<0.01$), hypoglycemia (from 4.5% to 3.9%, $P<0.01$), anxiety (from 4.5% to 1.9%, $P<0.01$), head trauma due to syncope (from 4.5% to 0%), cardiac arrest (1.1% to 0%), respiratory difficulties (from 2.2% to 1.9%, $P<0.01$), suspicion of myocardial infarction (from 2.2% to 0%), fall from stairs (from 2.2% to 0%) and agitation cases (from 1.1% to 0%) were reduced, however, the hypertension cases were dramatically increased (from 3.4% to 29.4%) owing to the hospital staff' education.

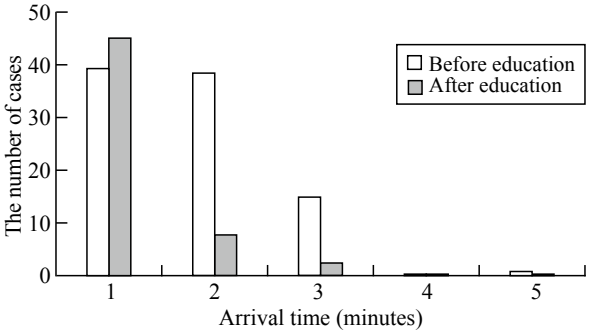

Figure 2. Education decreased arrival times of the Code Blue team.

DISCUSSION

The Code Blue system has been used to deal with unexpected and emergency cases in the Dr. Behçet Uz Children's Hospital where 139 Code Blue cases were

Table 1. Code Blue diagnosis before-and-after education of the children's hospital, *n* (%)

Variables	Before education	After education	*P*, *r**
Cardiac arrest	1 (1.1)	0 (0)	
Respiratory arrest	1 (1.1)	1 (1.9)	
Conversive disorder	23 (26)	7 (13)	<0.01, =1
Syncope	19 (21.5)	10 (19.6)	<0.01, =1
Convulsion	15 (17)	7 (13.7)	<0.01, =1
Hypotension	7 (8)	6 (11.7)	<0.01, =1
Hypoglycemia	4 (4.5)	2 (3.9)	<0.01, =1
Anxiety	4 (4.5)	1 (1.9)	<0.01, =1
Head trauma due to syncope	4 (4.5)	0 (0)	
Hypertension	3 (3.4)	15 (29.4)	<0.01, =0.837
Respiratory difficulties	2 (2.2)	1 (1.9)	<0.01, =1
MI suspicion	2 (2.2)	1 (1.9)	<0.01, =1
Fall from stairs	2 (2.2)	0 (0)	
Agitation	1 (1.1)	0 (0)	

*: Statistical difference *P*, Pearson's correlation coefficient *r*.

Table 2. The Code Blue Call studies in our country

References	Number of cases	Genders		Mean age	Arrival time (minutes)	Frequent code blue call hours	False calls
		M	F				
Koltka et al[9]	610	309 (50.6%)	287 (47%)	–	4.02	–	39.19%
Canural et al[8]	23	–	–	–	8	–	74%
Bal et al[11]	137	–	–	–	2.17	–	–
Mehel et al[10]	164	–	–	–	1.34	–	4%
Yılmaz et al[12]	65	30 (46.2%)	35 (53.8%)	–	1.81	–	–
Murat et al[7]	180	103 (57.2%)	77 (42.7%)	72 (27–92)	2.72	22:00–23:00	10%
Çiçekçi et al[6]	301	183 (60.8%)	118 (39.2%)	71.5 (16–102)	1.7	06:00–07:00	21%
Evren Şahin et al	139	51 (36.7%)	88 (63.3%)	26.01 (0.25–84)	1.57	09:00–12:00	97.8%

between January 2014 and January 2015. The overall results of Code Blue Calls conducted in our country were summarized in Table 2 where the Code Blue cases in our hospital were compared with the other studies, 88 (63.3%) of 139 cases were females and 51 (36.7%) were males. The female rate was significantly higher than that in the other studies because a large number of child patients were accompanied by their mothers admitted to the children's hospital. The mean age of our Code Blue cases was 26.01 years old, which span from 3 months to 84 years old, was dramatically less than the other studies in Table 2, owing to the children's hospital cases.[5–7]

As for the arrival time evaluation, the arrival time of Code Blue teams of our hospital ranged from 1 to 5 minutes which was concordant with the standards and the mean was 1.57 minutes. This was less than the other studies except one when it was compared with each other.[6–9,11,12]

When the frequent Code Blue Calls were compared, Çiçekçi et al[6] reported the most frequent hours as 06:00–07:00, Murat et al[7] reported as 22:00–23:00, however most frequent hours for Code Blue Calls of our hospital were between 09:00 and 12:00 due to children and their parents of our Children's hospital. Meanwhile, approximately 79.2% the Code Blue Calls were made during work hours and about 20.8% were made during shift hours.

Of the 139 total calls which were obtained from before-and-after staff's education of the hospital, 136 were considered as inconvenient calls. These false call process forming the basis of our study was frequently experienced in our hospital. Approximately, 97.8% of the Code Blue cases were false calls as the code blue process might be initiated for unnecessary cases. This rate was higher compared to the other studies in our country which were 74% by Canural et al,[8] 39.19% by Koltka et al,[9] 21% by Çiçekçi et al,[6] 10% by Murat et al,[7] 4% by Mehel et al,[10] 0% by Bal et al,[11] 0% by Yılmaz et al[12] in Table 2, because the staff might initiate the Code Blue process under any dangerous and at-risk situations. Moreover, the reason for this was observed as pressure to the hospital staff by the patient relatives as the hospital is a busy regional hospital and the relatives are highly sensitive for their children seeking emergency medical care. Arrival of an intervention team prevents development of unnecessary "White Code" calls. Another reason for these negative higher rates was observed as the attitude of the hospital staff. Unfortunately, there is no chance to initiate the colored alarm but Code Blue. It is obvious that the new colored alarm process and confirmation step should be required.

In conclusion, it is clear that the awareness of the true Code Blue events was improved after education of the hospital staff in the Children's Hospital. The related cases that do not require emergency medical intervention lead to personnel mistrust and loss of time during the verification process, and decrease success rates and loss of work power. It is obvious that the new colored alarm process and confirmation step should be required to improve better Patient and Personnel Safety Regulations in Turkey.

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Ethical approval: The Institutional Review Board of the hospital approved the study. The study was conducted in accordance with the principles of the *Declaration of Helsinki.*

Conflicts of interest: We have no conflicts of interest to report.

Contributors: KES and OZO proposed the study and designed the trials. KES, SY, AG and SD supervised the conduct of the trial and data collection. OZO managed the data, including quality control. KES and SY provided statistical analysis on the data; KES, AG and SD drafted the manuscript, and all authors contributed. KES takes responsibility for the paper as a whole.

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